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VARIATION IN THE DEER-MOUSE, *PEROMYSCUS MANICULATUS,* IN PARTS OF OREGON, CALIFORNIA, AND BAJA CALIFORNIA

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CONTENTS

Introduction 1
Acknowledgments 1
Methods of Study 2
Stocks of Deer-mice 2
Variation in *rubidus* 4
Variation in *sonoriensis* and *gambeli* 8
Variation in *assimilis* and *exiguus* 9
Summary 10
Literature Cited 11

INTRODUCTION

The stocks of deer-mice, *Peromyscus maniculatus,* here described illustrate the considerable variation in this species along the Pacific coast from northern Oregon to northern Baja California. The subspecies *rubidus* is represented by five stocks. From the range of *gambeli* there are two, and from that of *sonoriensis,* three stocks. The island races *assimilis* and *exiguus* are each represented by a single stock.

ACKNOWLEDGMENTS

The Carlotta, Victorville, La Jolla, San Felipe Valley, Kane Springs, and North Coronados Island stocks were collected by Francis B. Sumner, who kindly sent them to me. The Eugene and Port Orford stocks were collected by R. R. Huestis and sent to Sumner, who later transmitted them to me. The Coos Head stock was also collected by Huestis, but it was shipped directly to this laboratory. The Tillamook stock was collected by Alexander Walker. Seth B. Benson collected the Los Banos stock. The San Martin Island stock was collected by W. H. Burt while he was on an expedition from the University of Michigan Museum of Zoology.

The expenses of the laboratory study have been defrayed by the University of Michigan through the Faculty Research Fund, Museum of Zoology, and Laboratory of Vertebrate Genetics.

METHODS OF STUDY

The methods of study employed are similar to those used in my previous investigations of variation in *Peromyscus* (see Dice, 1932). All the animals here described were born and reared under fairly uniform laboratory conditions. There have been only slight changes in the ration fed them and in the conditions in the rooms in which they have been reared during the period of years over which the study has extended. All the mice included in the tables were of the one-year age class, and when killed for measurement all were between the ages of thirty-six and seventy-eight weeks.

Any difference between two means that is greater than about 2.7 times its standard error is here considered to be significant. A stock is said to rank large or small in any measurement when its mean does not differ significantly from the largest or smallest mean, respectively, of the series compared.

STOCKS OF DEER-MICE

Little information is available about the stations at which these stocks of deer-mice were trapped. It is believed that at least some of the collecting stations extended over a number of miles of country. It is further suspected that at some of the stations trapping was conducted in somewhat diverse types of ecologic conditions. These stocks therefore may not be exactly comparable with the stocks that I have previously described, most of which were taken at restricted localities within a single ecologic association.

Several of these stocks were considerably inbred in the laboratory, and their measurements therefore may not indicate the full range of variability of the respective natural populations from which they were descended. This is particularly true of the stocks from Carlotta, Victorville, and North Coronados Island, all of which had been in Sumner's laboratory for several years before they were sent to me. The Tillamook stock was derived from a single pair of field-caught animals.

The following stocks of deer-mice (see Map 1) have been available for this study:

Tillamook. From near Tillamook, Tillamook County, Oregon.

Eugene. Taken near Eugene, Lane County, Oregon.

Coos Head. Taken in Coos Head State Park, Coos County, Oregon.

Port Orford. From near Port Orford, Curry County, Oregon.

Carlotta. Taken near Carlotta, Humboldt County, California.

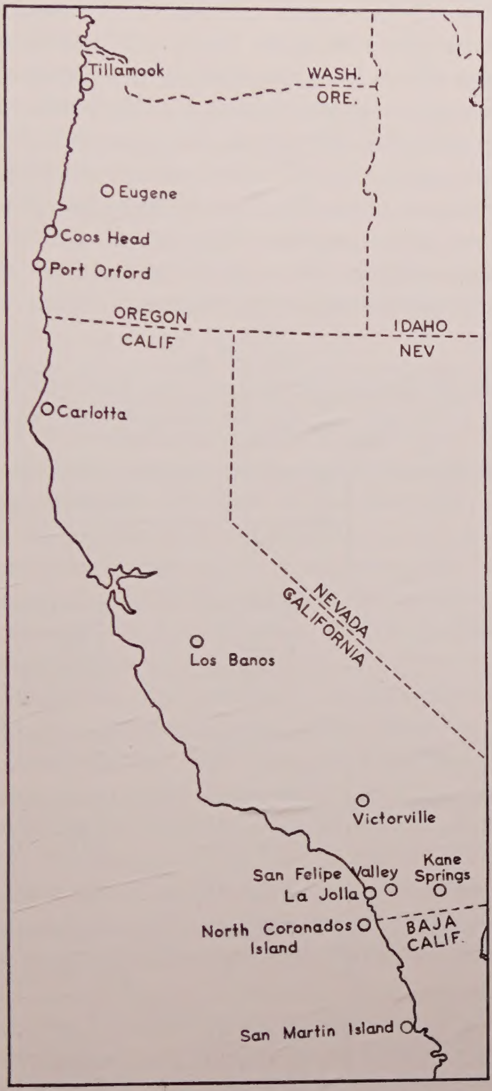
Los Banos. Taken in the vicinity of Los Banos, Merced County, California.

Victorville. From near Victorville, San Bernardino County, California.

La Jolla. Taken in the vicinity of La Jolla, San Diego County, California.

San Felipe Valley. From the San Felipe Valley within a mile of the head of Sentenac Canyon, in San Diego County, California. The locality is about eight miles east and a little north of Julian.

Kane Springs. Taken nine miles west of Kane Springs, Imperial County, California.



MAP 1. The location of the several stations at which collections were made for this study.

North Coronados Island. From the northern island of the Coronados group, Baja California.

San Martin Island. Taken on San Martin Island, Baja California.

The measurements of the Victorville stock have previously been published (Dice, 1935), but are repeated in the tables for comparison.

VARIATION IN *RUBIDUS*

The stocks from Tillamook, Eugene, Coos Head, Port Orford, and Carlotta fall within the geographic range of the subspecies *Peromyscus maniculatus rubidus* (Osgood, 1909: Pl. I). This subspecies may be distinguished from the others here described by its very dark pelage. Every one of the *rubidus* stocks averages significantly lower in tint photometer readings than any here described stock belonging to a different subspecies.

The Eugene mice are the darkest of the five stocks of *rubidus*. No other stock has, for any color screen, significantly lower tint photometer readings, either of the dorsal stripe or side of the body. Furthermore, for green and blue-violet reflected from the side of the body the Eugene mice have significantly lower readings than any other stock (Table I).

TABLE I

PELAGE COLOR OF *PEROMYSCUS MANICULATUS* FROM THE PACIFIC COAST

Mean tint photometer readings and standard errors, one-year age class, both sexes, in per cent

Stock	Dorsal Stripe		
	Red	Green	Blue-violet
rubidus			
Tillamook	4.77 ± .23	3.68 ± .20	3.05 ± .19
Eugene	4.64 ± .07	3.35 ± .06	2.66 ± .05
Coos Head	6.35 ± .12	5.16 ± .10	4.07 ± .03
Port Orford	4.36 ± .13	3.39 ± .09	3.92 ± .10
Carlotta	7.88 ± .13	5.21 ± .10	4.00 ± .09
gambeli			
Los Banos	15.93 ± .38	10.61 ± .26	8.00 ± .19
La Jolla	9.52 ± .10	6.65 ± .08	5.10 ± .06
sonoriensis			
Victorville	22.30 ± .40	15.58 ± .34	12.17 ± .29
San Felipe Valley	12.45 ± .19	8.62 ± .13	6.14 ± .11
Kane Springs	13.58 ± .39	9.75 ± .25	6.96 ± .20
assimilis			
North Coronados Island	9.18 ± .11	6.70 ± .10	5.41 ± .08
exiguus			
San Martin Island	10.83 ± .17	8.55 ± .13	6.75 ± .12
	Side Stripe		
rubidus			
Tillamook	13.27 ± .41	9.14 ± .37	7.59 ± .28
Eugene	11.85 ± .13	8.14 ± .10	6.19 ± .08
Coos Head	12.24 ± .17	9.37 ± .14	7.62 ± .13
Port Orford	12.81 ± .30	9.56 ± .22	7.69 ± .21
Carlotta	17.15 ± .20	11.24 ± .16	8.47 ± .14
gambeli			
Los Banos	26.73 ± .42	17.23 ± .32	12.91 ± .24
La Jolla	20.79 ± .17	14.58 ± .14	11.09 ± .11
sonoriensis			
Victorville	34.15 ± .39	23.13 ± .29	18.10 ± .25
San Felipe Valley	24.65 ± .30	16.87 ± .20	12.24 ± .19
Kane Springs	26.63 ± .49	18.00 ± .31	12.60 ± .30
assimilis			
North Coronados Island	18.91 ± .16	13.89 ± .13	11.12 ± .12
exiguus			
San Martin Island	21.08 ± .22	16.25 ± .21	12.46 ± .19

The Carlotta mice are palest of the *rubidus* stocks. For dorsal stripe red and for all the readings of the side of the body they average significantly higher in tint photometer readings than the mice of any other *rubidus* stock.

The Tillamook, Port Orford, and Coos Head stocks rank intermediate among the *rubidus* stocks in depth of color. There is no statistically significant difference between their mean tint photometer readings of side color. In readings of the dorsal stripe, however, the Coos Head stock has significantly higher readings than the other two stocks for red and for green. For dorsal stripe blue-violet the Coos Head and Carlotta stocks both significantly exceed the Tillamook stock in readings.

No attempt can be made to correlate the differences in pelage color between the several stocks of *rubidus* and any environmental feature. Any such attempt would be especially hazardous in view of the small number of stocks and the slight information available about the character of their habitats. Considerable differences in hair types between stocks of *rubidus* from diverse types of habitats have been demonstrated by Huestis (1932). These differences in hair type are presumably indicative of differences in color. It may be, therefore, that part of the differences in color between the several stocks of *rubidus* here described is based on differences in the habitats where they were taken.

In their dimensions of body and skeleton the *rubidus* stocks vary more among themselves and differ less from the stocks of other subspecies than they do in pelage color (Table II).

The *rubidus* stocks are most distinct from the other subspecies in tail length, in which they significantly exceed all the other stocks except *assimilis* from North Coronados Island. The Tillamook mice have significantly longer tails than any other stock here described. The Coos Head, Port Orford, North Coronados Island, and Carlotta stocks form a group the members of which do not differ significantly from one another in tail length, except that the Coos Head stock significantly exceeds the Carlotta stock. All these stocks have significantly longer tails than has the Eugene stock, which in its turn significantly exceeds in this measurement all the remaining stocks here described.

In body length the Port Orford mice rank large and the Carlotta mice small among the stocks here compared. In hind foot length the Port Orford and Coos Head stocks rank large, whereas the Carlotta stock is fairly small, for only the Los Banos and Victorville stocks have significantly shorter feet. In ear length the Coos Head and Port Orford mice are significantly exceeded only by the San Martin Island mice, and the Carlotta mice rank small. In femur length the Port Orford and Carlotta mice are significantly exceeded only by the North Coronados Island mice, and the Eugene mice rank small. In length of mandible the Port Orford mice rank large, and only the Victorville mice average significantly smaller than the Carlotta mice. In condylopremaxillary skull length the Port Orford mice average significantly larger

TABLE II

MEASUREMENTS OF *PEROMYSCUS MANICULATUS* FROM THE PACIFIC COAST

Means and standard errors of one-year age class, both sexes, in millimeters

Stock	No.	Mean Age in Weeks	No. of Parents	Body Length	Tail Length	Hind-foot Length	Ear Length
rubidus							
Tillamook	15	48	2	92.93 ± .91	99.20 ± 1.57	21.867 ± .168	18.280 ± .159
Eugene	117	56	14	92.91 ± .40	82.77 ± .60	21.038 ± .054	17.380 ± .079
Coos Head	86	52	9	96.58 ± .52	92.65 ± .54	22.281 ± .079	18.662 ± .099
Port Orford	36	58	8	102.08 ± .71	91.55 ± .88	22.344 ± .116	18.638 ± .109
Carlotta	18	57	3	88.17 ± .52	88.75 ± .85	20.372 ± .180	16.728 ± .084
gambeli							
Los Banos	70	56	6	93.01 ± .43	67.57 ± .46	19.514 ± .060	17.946 ± .061
La Jolla	171	56	8	95.29 ± .32	75.44 ± .47	20.467 ± .049	18.282 ± .053
sonoriensis							
Victorville	65	48	5	88.81 ± .39	73.37 ± .47	19.266 ± .066	16.686 ± .067
San Felipe Valley	103	51	10	95.18 ± .46	75.02 ± .55	20.590 ± .057	17.916 ± .073
Kane Springs	48	58	3	94.38 ± .45	76.77 ± .70	21.412 ± .087	18.327 ± .143
assimilis							
North Coronados Island	54	56	5	94.41 ± .50	91.00 ± .53	21.896 ± .088	18.833 ± .061
exiguus							
San Martin Island	66	53	10	99.12 ± .44	70.27 ± .49	21.680 ± .080	19.748 ± .084

TABLE II—(*Cont.*)

Stock	Left Femur	Left Mandible	Condyle-premaxilla	Condyle-zygoma	Bullar Width
rubidus					
Tillamook	....	....	....	....	....
Eugene	15.981 ± .067	15.700 ± .045	24.191 ± .070	17.328 ± .053	10.607 ± .030
Coos Head	16.621 ± .079	16.676 ± .067	25.226 ± .105	17.717 ± .073	11.188 ± .086
Port Orford	17.409 ± .128	16.762 ± .088	25.765 ± .140	18.244 ± .087	11.085 ± .047
Carlotta	16.947 ± .136	15.650 ± .083	24.069 ± .128	17.250 ± .076	10.725 ± .041
gambeli					
Los Banos	15.973 ± .062	15.457 ± .049	23.744 ± .062	17.045 ± .047	10.736 ± .030
La Jolla	16.447 ± .050	15.845 ± .028	24.205 ± .042	17.287 ± .031	10.689 ± .019
sonoriensis					
Victorville	15.692 ± .084	15.129 ± .065	23.378 ± .089	17.044 ± .063	10.655 ± .035
San Felipe Valley	16.451 ± .078	15.574 ± .050	24.066 ± .074	17.412 ± .053	10.698 ± .022
Kane Springs	16.572 ± .076	15.895 ± .053	24.450 ± .075	17.547 ± .058	10.975 ± .034
assimilis					
North Coronados Island	17.881 ± .098	16.631 ± .058	24.958 ± .065	17.729 ± .057	10.915 ± .023
exiguus					
San Martin Island	16.436 ± .086	16.907 ± .043	25.296 ± .070	18.206 ± .051	11.231 ± .034

than any other of the stocks, and only the Victorville mice average significantly smaller than the Carlotta mice. In the measurement of condylozygomatic distance the Port Orford mice rank large, and again only the Victorville mice average significantly smaller than the Carlotta mice. In bullar width of skull the Coos Head and Port Orford mice rank large, and the Eugene mice rank small.

It is evident then that in its dimensions the subspecies *rubidus* is distinguished from the other subspecies here compared only in length of tail. All the stocks of *rubidus* have longer tails on the average than any other of the subspecies, except only *assimilis* from North Coronados Island. On the other hand, the stocks of *rubidus* vary considerably among themselves in their other dimensions of body and skeleton, and in these other measurements they broadly overlap the other subspecies.

VARIATION IN *SONORIENSIS* AND *GAMBELI*

The subspecies *gambeli* is said by Osgood (1909: 67) to be decidedly darker and slightly smaller than *sonoriensis*. In California, *sonoriensis* occupies in general the Colorado and Mohave deserts and the adjacent mountain ranges to the westward, whereas *gambeli* ranges over a considerable part of the rest of the state (Grinnell, 1933: 174). The stocks from Los Banos and La Jolla must therefore be assigned to *gambeli* and those from Victorville, Kane Springs, and San Felipe Valley to *sonoriensis*.

In color the Victorville deer-mice are pale. They average significantly higher in tint photometer readings, both of the dorsal stripe and the side of the body, than any other of the California stocks here described. The Victorville stock also averages considerably higher in tint photometer readings than the stocks from Oracle and Miller Canyon, Arizona, previously described (Dice, 1938: 14). The Victorville stock, however, was already considerably inbred when received by me, and it possibly may have been selected for pale color. It may therefore not correctly represent the color of the population at Victorville.

The La Jolla deer-mice are darker than any other of the stocks assigned to *sonoriensis* or *gambeli*. Their tint photometer readings average significantly lower than those of either the Victorville, Kane Springs, San Felipe Valley, or Los Banos mice. Their readings are, however, significantly higher, as already stated, than those of any of the *rubidus* stocks.

The Los Banos, Kane Springs, and San Felipe Valley stocks are intermediate in color between the Victorville and La Jolla stocks. The Los Banos stock is somewhat paler than either the Kane Springs or San Felipe Valley stocks, for it significantly exceeds them both in readings for dorsal stripe red and blue-violet, and it also significantly exceeds the San Felipe Valley stock in readings for dorsal stripe green, side red, and side green. The San Felipe Valley stock is the darkest of the three intermediate stocks, for it is significantly exceeded by the Kane Springs stock in readings for dorsal stripe green, dorsal stripe blue-violet, side red, and side green.

These data demonstrate that the mice from the Colorado and Mohave deserts of California are paler than those living in southern California near the shore of the Pacific Ocean. The Victorville and Kane Springs stocks both have significantly higher tint photometer readings than has the La Jolla stock. Moreover, the mice from Los Banos, in the San Joaquin Valley, which on geographic position must be assigned to the subspecies *gambeli,* are at least as pale as those from Kane Springs, which are assumed to be *sonoriensis.* The mice from the San Felipe Valley are very slightly paler than those from Los Banos and Kane Springs and may be assumed therefore to be somewhat intermediate between *gambeli* and *sonoriensis,* as one would expect from their geographical position.

The dimensions of the body and skeleton vary considerably in the several stocks of *sonoriensis* and *gambeli.* The Victorville stock, which is undoubtedly *sonoriensis,* ranks small among these stocks in all measurements except tail length, in which it significantly exceeds the Los Banos stock. On the other hand, the Kane Springs stock, which also must be assumed to be *sonoriensis,* ranks large among these five stocks in every measurement except body length, in which it is significantly exceeded by the La Jolla stock. The La Jolla stock, which must be assigned to *gambeli,* also ranks large in most measurements, but it is significantly exceeded in hind-foot length, condylo-premaxillary skull length, condylo-zygomatic distance, and bullar width of skull by the Kane Springs stock. The measurements of Sumner (1920, Table 1) also demonstrate that most of the body and skeletal measurements of the La Jolla mice exceed those of the Victorville mice and that some of the differences are of statistical significance.

The statement that the subspecies *gambeli* is slightly smaller than *sonoriensis* is not supported by these comparisons. The number of localities represented in this report, however, is few, and no general comparison of the measurements of the two subspecies from the various parts of their ranges is possible at this time.

VARIATION IN *ASSIMILIS* AND *EXIGUUS*

The subspecies *assimilis* (Nelson and Goldman, 1931*a*: 305–6) is limited to the Coronados Islands, a small group lying just off the coast of Baja California, only a few miles southwest of San Diego. The stock is from the most northern of these islands.

In pelage color the North Coronados Island mice are close to the La Jolla mice of the subspecies *gambeli* from the California mainland. There is no statistically significant difference between the two stocks in tint photometer readings for dorsal stripe red or green, or for side blue-violet. For dorsal stripe blue-violet the Coronados mice have significantly the higher readings, but for side green the readings of the La Jolla mice average significantly the higher.

In size the North Coronados Island mice average significantly larger in every dimension except body length than do the La Jolla mice. The

Coronados mice also average significantly longer in length of femur than any other stock of deer-mice here compared. In every other measurement they are, however, significantly exceeded by one or more other stocks.

Compared to *gambeli* from the adjacent mainland, *assimilis* is said by Nelson and Goldman (1931*a*: 306) to have "decidedly larger general size, larger, heavier skull, and much darker and richer color." The generally large dimensions of the Coronados mice compared to the La Jolla mice support the first part of this statement. On the other hand, there is no important difference in color between the two stocks, and the statement in regard to a color difference between the two subspecies therefore is not confirmed. It should be borne in mind, however, that only a single stock of each of the mainland and island forms is available for comparison. There is probably local variation in both subspecies, and other stocks of either, if available, would probably show different average measurements and tint photometer readings than those of the stocks at hand. There is also the possibility that because the North Coronados Island stock was somewhat inbred when received it may not fully represent the characters of the population living on the island.

Peromyscus maniculatus exiguus is restricted to the island of San Martin, that lies only a few miles off the coast of Baja California (Nelson and Goldman, 1931*b*: 534–35; and 1932: 370–71).

In color the San Martin mice are somewhat paler than either the La Jolla or North Coronados Island animals. Their tint photometer readings average significantly higher than either, except only that their readings for side red do not differ significantly from those of the La Jolla mice.

In length of ear the San Martin mice significantly exceed any other stock of mice here compared. They also average significantly larger than either the La Jolla or North Coronados Island mice in body length, length of mandible, condylo-premaxillary skull length, condylo-zygomatic distance, and bullar width of skull. In hind foot length the San Martin Island mice significantly exceed the La Jolla but not the North Coronados Island animals. In femur length they significantly exceed the North Coronados but not the La Jolla mice. In length of tail they average significantly shorter than either the North Coronados or La Jolla mice.

The subspecies *exiguus* from San Martin Island, so far as may be judged from the stocks available for comparison, is, in general, paler than either *assimilis* from North Coronados Island or *gambeli* from the coast of southern California. This confirms statements made by Nelson and Goldman (1931*b*: 534–35, under *martinensis*). *Exiguus* also is somewhat larger in most dimensions of body and skeleton than either of these other subspecies, but it is shorter in tail length.

SUMMARY

Of the several stocks and subspecies of deer-mice here compared, *Peromyscus maniculatus rubidus* from the coast of Oregon and northern

California is the darkest in pelage. *Rubidus* also averages longer in tail length than any other subspecies except *assimilis*.

The stocks of deer-mice from the Mohave and Colorado deserts and from the San Joaquin Valley are paler than the one from the southern coast of California. There are, on the other hand, no consistent differences in dimensions between the several stocks of *gambeli* and *sonoriensis* here described.

The subspecies *assimilis*, represented by a stock from North Coronados Island, is larger in most dimensions but similar in color to *gambeli* from the adjacent mainland at La Jolla. In all measurements except femur length, however, *assimilis* is equaled or exceeded by one or more stocks of other subspecies.

The subspecies *exiguus* from San Martin Island is in general paler and larger, except in length of tail, than *assimilis* or *gambeli*. In ear length *exiguus* significantly exceeds all the other forms here compared.

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